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International Bureau



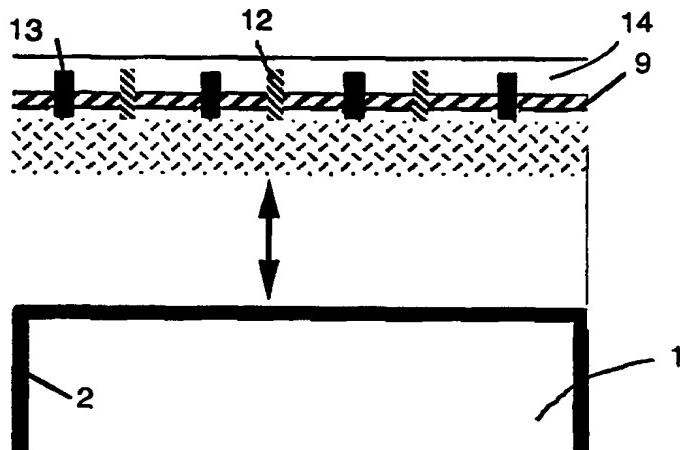
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : <b>H01L 21/20, 31/18</b>	A1	(11) International Publication Number: <b>WO 00/45426</b> (43) International Publication Date: 3 August 2000 (03.08.00)
(21) International Application Number: <b>PCT/EP00/00586</b>		(81) Designated States: AU, IN, JP, US, ZA, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).
(22) International Filing Date: 26 January 2000 (26.01.00)		
(30) Priority Data: 99200235.2 27 January 1999 (27.01.99) EP		Published <i>With international search report.</i>
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(72) Inventors; and		
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(74) Agents: BIRD, William et al.; Bird Goën & Co., Termerestraat 1, B-3020 Winksele (BE).		

(54) Title: METHOD FOR FABRICATING THIN FILM SEMICONDUCTOR DEVICES

(57) Abstract

The present invention is related to a method for fabricating thin film semiconductor devices on a reusable high-quality substrate. Examples of such devices are solar cells, light emitting diodes and power devices. The invented method allows for simple and cheap processing techniques like for instance screen printing and electroless etching to be successfully applied in combination with thin film semiconductor devices of only a few  $\mu\text{m}$  thickness using very cheap supports such as plastic films. After being attached to a cheap second substrate, i.e. the support the completed thin film semiconductor devices are lifted off from the reusable by substrate a wet etching technique using said support as a mask. The high-quality substrate is recycled and can be used for many processing cycles.



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# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/EP 00/00586

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 H01L21/20 H01L31/18

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 856 229 A (YONEHARA TAKAO ET AL) 5 January 1999 (1999-01-05) cited in the application column 4, line 66 -column 5, line 10 column 20, line 54 -column 21, line 40; figure 5	1,3-8, 11,13, 14,16
A	WO 99 01893 A (MAX PLANCK GESELLSCHAFT ;BRENDEL ROLF (DE)) 14 January 1999 (1999-01-14) cited in the application page 16, line 23 -page 18, line 27 page 26, line 25 -page 29, line 12; claim 11; figure 1	17
Y	— — —/—	1,3-8, 11,13, 14,16

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

\* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

28 April 2000

Date of mailing of the international search report

17/05/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl.  
Fax: (+31-70) 340-3016

Authorized officer

Acco, S

**INTERNATIONAL SEARCH REPORT**

Inte onal Application No

PCT/EP 00/00586

**C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT**

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 851 513 A (CANON KK) 1 July 1998 (1998-07-01) page 10, line 29 -page 11, line 39; figure 5 -----	1,11,13, 14,16
A	EP 0 851 511 A (IMEC VZW) 1 July 1998 (1998-07-01) column 5, line 2 -column 6, line 8 column 9, line 40 -column 10, line 44; figure 10 -----	1,9-15

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 00/00586

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US 5856229	A 05-01-1999	JP 7302889 A JP 11135761 A JP 11135762 A		14-11-1995 21-05-1999 21-05-1999
WO 9901893	A 14-01-1999	DE 19730975 A		07-01-1999
EP 0851513	A 01-07-1998	JP 10189924 A JP 10190029 A AU 4926897 A CN 1192055 A		21-07-1998 21-07-1998 02-07-1998 02-09-1998
EP 0851511	A 01-07-1998	AU 5955598 A WO 9828798 A EP 0960443 A		17-07-1998 02-07-1998 01-12-1999

## PATENT COOPERATION TREATY

PCT

From the INTERNATIONAL BUREAU

To:

BIRD, William  
 Bird Goën & Co.  
 Vilvoordsebaan 92  
 B-3020 Winksele  
 BELGIQUE

Date of mailing (day/month/year) 08 September 2000 (08.09.00)
--

Applicant's or agent's file reference IL433-PCT	<b>IMPORTANT NOTIFICATION</b>
International application No. PCT/EP00/00586	International filing date (day/month/year) 26 January 2000 (26.01.00)

## 1. The following indications appeared on record concerning:

the applicant     the inventor     the agent     the common representative

Name and Address  BIRD, William Bird Goën & Co. Termerestraat 1 B-3020 Winksele Belgium	State of Nationality	State of Residence
	Telephone No.	
	32 16 48 05 62	
	Facsimile No.	
	32 16 48 05 28	
	Teleprinter No.	

## 2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

the person     the name     the address     the nationality     the residence

Name and Address  BIRD, William Bird Goën & Co. Vilvoordsebaan 92 B-3020 Winksele Belgium	State of Nationality	State of Residence
	Telephone No.	
	32 16 48 05 62	
	Facsimile No.	
	32 16 48 05 28	
	Teleprinter No.	

## 3. Further observations, if necessary:

## 4. A copy of this notification has been sent to:

<input checked="" type="checkbox"/> the receiving Office	<input checked="" type="checkbox"/> the designated Offices concerned
<input type="checkbox"/> the International Searching Authority	<input type="checkbox"/> the elected Offices concerned
<input type="checkbox"/> the International Preliminary Examining Authority	<input type="checkbox"/> other:

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland  Facsimile No.: (41-22) 740.14.35	Authorized officer  Jean-Marie McAdams  Telephone No.: (41-22) 338.83.38
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## PATENT COOPERATION TREATY

PCT

**NOTIFICATION OF ELECTION**  
 (PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents  
 United States Patent and Trademark  
 Office  
 Box PCT  
 Washington, D.C.20231  
 ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 13 September 2000 (13.09.00)
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International application No. PCT/EP00/00586	Applicant's or agent's file reference IL433-PCT
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International filing date (day/month/year) 26 January 2000 (26.01.00)	Priority date (day/month/year) 27 January 1999 (27.01.99)
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Applicant  HORZEL, Jörg et al
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1. The designated Office is hereby notified of its election made:

in the demand filed with the International Preliminary Examining Authority on:

16 August 2000 (16.08.00)

in a notice effecting later election filed with the International Bureau on:

\_\_\_\_\_

2. The election  was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer  Juan Cruz
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>IL433-PCT</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/EP 00/00586</b>	International filing date (day/month/year) <b>26/01/2000</b>	(Earliest) Priority Date (day/month/year) <b>27/01/1999</b>
Applicant <b>INTERUNIVERSITAIRE MICROELEKTRONICACENTRUM VZW</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 4 sheets.

It is also accompanied by a copy of each prior art document cited in this report.

**1. Basis of the report**

- a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
  - the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).
- b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing :
  - contained in the international application in written form.
  - filed together with the international application in computer readable form.
  - furnished subsequently to this Authority in written form.
  - furnished subsequently to this Authority in computer readable form.
  - the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
  - the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2.  Certain claims were found unsearchable (See Box I).

3.  Unity of Invention is lacking (see Box II).

4. With regard to the title,

- the text is approved as submitted by the applicant.
- the text has been established by this Authority to read as follows:

5. With regard to the abstract,

- the text is approved as submitted by the applicant.
- the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No.

- as suggested by the applicant.
- because the applicant failed to suggest a figure.
- because this figure better characterizes the invention.

1m

None of the figures.

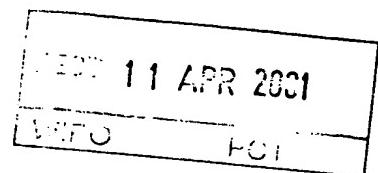
## Box III TEXT OF THE ABSTRACT (Continuation of item 5 of the first sheet)

The abstract is modified as follows:

The present invention is related to a method for fabricating thin film semiconductor devices on a reusable high-quality substrate. Examples of such devices are solar cells, light emitting diodes and power devices. The invented method allows for simple and cheap processing techniques like for instance screen printing and electroless etching to be successfully applied in combination with thin film semiconductor devices of only a few  $\mu\text{m}$  thickness using very cheap supports such as plastic films. After being attached to a cheap second substrate, i.e. the support the completed thin film semiconductor devices are lifted off from the reusable substrate by a wet etching technique using said support as a mask. The high-quality substrate is recycled and can be used for many processing cycles.

## ATENT COOPERATION TREATY

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## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference <b>IL433-PCT</b>	<b>FOR FURTHER ACTION</b>	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. <b>PCT/ EP 00/ 00586</b>	International filing date ( <i>day/month/year</i> ) <b>26/01/2000</b>	Priority date ( <i>day/month/year</i> ) <b>27/01/1999</b>
International Patent Classification (IPC) or national classification and IPC <b>H01L21/20</b>		
Applicant <b>INTERUNIVERSITAIRE MICROELEKTRONICACENTRUM VZW</b>		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consists of a total of \_\_\_\_\_ sheets.

3. This report contains indications relating to the following items:

- I  Basis of the report
- II  Priority
- III  Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV  Lack of unity of invention
- V  Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI  Certain documents cited
- VII  Certain defects in the international application
- VIII  Certain observations on the international application

Date of submission of the demand <b>16/08/2000</b>	Date of completion of this report <b>09.04.01</b>
Name and mailing address of the IPEA/ European Patent Office D-80298 Munich Tel. (+49-89) 2399-0, Tx: 523656 epmu d Fax: (+49-89) 2399-4465	Authorized officer <b>F. ROUBERT</b>



**INTERNATIONAL PRELIMINARY EXAMINATION REPORT****I. Basis of the report**

1. This report has been drawn up on the basis of (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*)

the international application as originally filed

the description, pages , as originally filed  
pages , filed with the demand  
pages , filed with the letter of

the claims, Nos. , as originally filed  
Nos. , as amended under Article 19  
Nos. , filed with the demand  
Nos. , filed with the letter of

the drawings, sheets / fig. , as originally filed  
sheets / fig. , filed with the demand  
sheets / fig. , filed with the letter of

2. The amendments have resulted in the cancellation of:

the description, pages:  
 the claims, Nos.  
 the drawings, sheets / fig.

3.  This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2 (c)).

4. Additional observations, if necessary:

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement****1. Statement**

Novelty	Claims	1-18	YES
	Claims		NO
Inventive Step	Claims		YES
	Claims	1-18	NO
Industrial Applicability	Claims	1-18	YES
	Claims		NO

**2. Citations and Explanations**

The method of manufacturing a thin film solar cell on a reusable substrate disclosed in document D1: EP-A-0851513 (cf. Fig. 5; page 10, line 29 - page 11, line 39) comprises all features of Claim 1 except the last feature thereof since the separation of the substrate 201 from the semiconductor layer (203, 204) is made mechanically. In particular an active device (solar cell comprising a p-n junction) is formed in the semiconductor layer (n+ layer 206, p-layer 203, p+ layer 204: cf. page 10, lines 52-56) and an electrode 209 is formed on the semiconductor layer 204 before the second substrate (or support) 205 is bonded thereon (cf. page 10, line 58 - page 11, line 2).

It is, however, known from D2: US-A-5856 229 (cf. col. 21, lines 29-32) to detach an epitaxial semiconductor layer from the reusable substrate by etching the intermediate porous silicon layer. It is considered obvious to the person skilled in the art to apply the separation method according to D2 as an alternative equivalent method to the mechanical separation mentioned in D1 thereby arriving at the method according to Claim 1. The subject-matter of Claim 1 does therefore not involve an inventive step (Article 33(3) PCT).

In Claim 17 a slight constructional change in the method of Claim 1 is defined which comes within the scope of the customary practice followed by persons skilled in the art, especially as the advantages thus achieved can readily be foreseen. Consequently, the subject-matter of Claim 17 also lacks an inventive step.

Dependent Claims 2-16, 18 do not contain any features which, in combination with the

**INTERNATIONAL PRELIMINARY EXAMINATION REPORT**

International application No.

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features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step.

**INTERNATIONAL PRELIMINARY EXAMINATION REPORT**

International application No.

PCT/EP00/00586

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:

Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the document D1 is not mentioned in the description, nor is this document identified therein.

The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).